IN THE SPECIFICATION:

Please replace paragraph number **[0004]** with the following rewritten paragraph:

[0004] In response to the above-noted shortcomings of the existing packaging techniques, various structures using flip-chip mounting of an image sensor chip have been developed in an attempt to simplify the construction of image sensor packages. U.S. Patent 6,144,507 to Hashimoto and U.S. Patent 5,867,368 to Glenn, for example, each disclose an image sensor chip mounted directly to a printed circuit board (PCB). An image sensor chip is mounted in flip-chip fashion over an aperture within the PCB, and a transparent cover is either attached directly to the active surface of the chip or bonded to the side of the PCB opposite that to which the image sensor chip is attached and over the aperture. Although these methods eliminate the difficulties associated with wire bonding and forming a housing for the image sensor chip, the illustrated ~~PCB's~~ PCBs are very large with respect to the size of the image sensor chip and the transparent cover. It is unclear from the aforementioned patents whether the ~~PCB's~~ PCBs comprise discrete image sensor packages suitable for attachment to a larger circuit assembly, or themselves comprise large circuit assemblies simply having an image sensor chip mounted directly thereto, without the benefit of a package or housing.

Please replace paragraph number **[0007]** with the following rewritten paragraph:

[0007] In accordance with the present invention, image sensor packaging having the above-described and other beneficial characteristics and methods for fabrication thereof are provided. An image sensor chip is flip-chip mounted to conductive traces on a first surface of a transparent substrate. The active surface of the image sensor chip is protected from contamination after mounting by depositing a bead of sealant around the periphery of the image sensor chip between the active surface of the image sensor chip and the first surface of the substrate, thus eliminating any need for additional damming structures or spacing frames as used in the prior art. Discrete conductive elements such as solder balls or columns are attached to ends of the conductive traces which form an array pattern, the discrete conductive elements extending transversely from the conductive traces on the first surface to a substantially common

~~plane at~~ plane at a level beyond a back surface of the image sensor chip. The resulting structure comprises a board-over-chip (BOC) package arrangement that provides high I/O connectivity for the image sensor chip and is easily mounted to a carrier substrate such as a printed circuit board (PCB) without requiring the formation of special apertures therein.

Please replace paragraph number **[0031]** with the following rewritten paragraph:

[0031] Referring in general to the accompanying drawings, various aspects of the present invention are illustrated to show the structure and methods for assembly of an image sensor package formed on a transparent substrate. Common elements and features of the illustrated embodiments are designated by the same or similar reference numerals. It should be understood that the figures presented are not meant to be illustrative of actual views of any particular portion of the actual device structure, but are merely idealized schematic representations which are employed to more clearly and fully depict the invention. It should further be understood that, while depicted in terms of an image sensor, the package embodiments and methods presented herein would work well for other types of optically interactive electronic devices. The term "optically interactive" as used herein encompasses devices sensitive to various wavelengths of light or other forms of radiation, such as, but not limited to, CCD and CMOS image sensors, ~~EPROM's,~~ EPROMs, and photodiodes, as well as light-emitting devices such as semiconductor lasers and light-emitting diodes.

Please replace paragraph number **[0032]** with the following rewritten paragraph:

[0032] FIG. 1 shows a perspective view of an exemplary image sensor chip 2 suitable for use with the various embodiments of the present invention. Image sensor chip 2 includes an active surface 4 and a back surface 6. Active surface 4 and back surface 6 are bounded by sides 8, also termed the "periphery" of image sensor chip 2. Active surface 4 includes sensing circuitry 10 in a central portion and bond pads 12 formed outwardly of sensing circuitry 10 and around the perimeter of active surface 4. As used herein, the term "bond pads" includes not only bond pads directly connected to underlying sensing circuitry 10 but also bond pad locations

removed from original locations using a redistribution layer extending over active surface 4 as known in the art. Bond pads 12 are depicted in a single row along each of the four sides 8 of image sensor chip 2, but other arrangements are possible, for example and not by way of limitation, having bond pads 12 formed along fewer sides or in multiple rows along one or more sides. If multiple rows are used, the bond pads 12 of one row may be staggered or offset from those of an adjacent row. Conductive bumps 14 (only some shown by way of ~~example~~ example) are formed on bond pads 12 to enable flip-chip attachment of image sensor chip 2 and will be described in further detail below. For certain types of image sensors, micro-lenses 16 may be formed over sensing circuitry 10 to aid in the reception of light.

Please replace paragraph number **[0034]** with the following rewritten paragraph:

[0034] Turning to FIGS. 3 through 6, a first embodiment according to the present invention is illustrated. FIG. 3 shows a sectional side view of an image sensor package 24 wherein conductive traces 26 (thickness enlarged for clarity) are formed directly on second surface 22 of transparent substrate 18. As seen in FIG. 4, which is an underside plan view of second surface 22 as oriented in FIG. 3, conductive traces 26 have first attachment points 28 formed at locations around the center of transparent substrate 18 and corresponding to the spacing of bond pads 12 (FIG. 1) on image sensor chip 2. Spreading out from the center of transparent substrate 18, conductive traces 26 have second attachment points 30 formed in an array pattern. For purposes of illustration, second attachment points 30 have been depicted in a single row running around the center and proximate the periphery of transparent substrate 18. It should be understood, however, that the number of rows employed may be based on factors such as the number and arrangement of bond pads 12 on image sensor chip 2, and may comprise several rows of second attachment points 30. Conductive traces 26 may be formed on second surface 22 of transparent substrate 18 using a variety of techniques. For instance, a conductive or conductor-filled liquid epoxy or resin could be printed, screen-printed or otherwise dispensed onto second surface 22 in the desired pattern and then cured to form conductive traces 26. Alternatively, a layer of conductive material such as metal or doped silicon may be formed over

the entirety of second surface 22, and then selectively etched to form conductive traces 26. As yet another approach, adhesively coated preformed traces carried by a removable backing layer may be applied to transparent substrate 18 and then the backing layer removed.

Please replace paragraph number **[0044]** with the following rewritten paragraph:

[0044] Backing cap 48 may be used in combination with elements of both image sensor package 24 of the first embodiment and image sensor package 42 of the second embodiment. Rather than attaching discrete conductive elements 34 to second attachment points 30, backing cap attachment points 56 may be bonded to second attachment points 30 of conductive traces 26 for electrical communication with attachment pads 58. Second attachment points 30 and backing cap attachment points 56 may be bonded in a variety of ways, such as by application of conductive or conductor-filled epoxy or by forming a solder joint between the two. A frame comprising a film of anisotropically conductive adhesive material may also be applied between sidewalls 52 and transparent substrate 18 or secondary substrate 44, depending on the image sensor package embodiment elements used with backing cap 48. This approach electrically connects and bonds second attachment points 30 and backing cap attachment points 56, and further acts to seal backing cap 48 into place. With the third embodiment, second attachment points 30 may be formed much smaller than in the first two embodiments, as they are not required to support the formation of discrete conductive elements 34. Accordingly, an increased number of second attachment points 30 may be patterned around the outside of image sensor chip 2 for bonding with a corresponding number of backing cap attachment points 56. This makes it possible to electrically communicate with a fully populated array of attachment pads 58 for higher I/O connectivity. FIG. 11 shows a top plan view of backing cap 48 with an exemplary single row pattern of backing cap attachment points 56. It should also be noted that conductive lines 54 may be formed to extend from backing cap attachment points 56 and around the exterior of sidewalls 52 and over the back surface of base 50 to attachment ~~points~~ pads 58. Similarly, for simplicity, the portions of conductive lines 54 extending through sidewalls 52 may comprise vias leading to a redistribution layer of conductive traces formed over the back surface of base 50.

Please replace paragraph number **[0045]** with the following rewritten paragraph:

[0045] FIG. 12 shows a sectional side view of an image sensor package 60 according to the third embodiment of the present invention using a transparent substrate 18 with conductive traces 26 formed directly on second surface 22, as in the first embodiment. After electrical connection is made between backing cap attachment points 56 and second attachment points 30 of conductive traces 26, backing cap 48 is sealed to transparent substrate 18 with a layer or bead of dielectric adhesive 62. Alternatively, and as previously noted, an anisotropically conductive adhesive may be used to both electrically bond second attachment points 30 and backing cap attachment points 56 and seal between backing cap 48 and transparent substrate 18. Discrete conductive elements 34 are attached to or formed on attachment pads 58. Discrete conductive elements 34 may be formed as structures and of materials similar to those described in conjunction with the first and second embodiments of the present invention, but will not require as large a height as they are already located at a point below image sensor chip 2. Alternatively, since attachment pads 58 reside on a plane on the second surface of image sensor package 60, discrete conductive elements 34 may be omitted and attachment pads 58 directly attached to conductive terminal pads 40 on carrier substrate 38 in a land-grid array-type arrangement.

Please replace paragraph number **[0046]** with the following rewritten paragraph:

[0046] FIG. 13 shows a flow chart of an exemplary method of fabrication for the third embodiment of the present invention. First, in action 300, conductive traces 26 are formed on second surface 22 of transparent substrate 18 when using the packaging structure of the first ~~embodiment~~ embodiment. Alternatively, in action 300', secondary substrate 44 having aperture 46 and conductive traces 26 is adhesively secured to transparent substrate 18 when using the packaging structure of the second embodiment. In action 302, image sensor chip 2 is flip-chip mounted by bonding conductive bumps 14 to first attachment points 28. In action 304, a bead of sealant is deposited around image sensor chip 2, contacting sides 8 and transparent substrate 18 or secondary substrate 44 depending on the package structure used. Because image sensor chip 2 will be covered and sealed by backing cap 48, the sealant of action 304 may

optionally be, and preferably is, omitted. Next, in action 306, backing cap 48 is secured in place and second attachment points 30 and backing cap attachment points 56 are bonded for electrical communication. Finally, in action 308, if ~~a land grid array type~~ land-grid array-type package is not desired, discrete conductive elements 34 are formed on or attached to the full array of attachment pads 58.

Please replace paragraph number **[0048]** with the following rewritten paragraph:

[0048] FIG. 15A shows a sectional side view of an image sensor package 74 according ~~the~~ to the fourth embodiment of the present invention. Mounting portion 66 is adhesively secured to transparent substrate 18 in the same manner as secondary substrate 44 in the second embodiment. Backing portion 68 extends laterally outwardly from an edge of transparent substrate 18. Conductive bumps 14 on image sensor chip 2 are bonded to first attachment points 28 such that sensing circuitry 10 is exposed through aperture 46 (FIGS. 14A and 14B). A bead of sealant 36 is also deposited around the sides 8 of image sensor chip 2 and contacts first side 70 of flex circuit 64.

Please replace paragraph number **[0049]** with the following rewritten paragraph:

[0049] As seen in FIG. 15B, backing portion 68 is subsequently bent over or folded such that the full array of second attachment points 30 faces in a downward direction below image sensor chip 2. In a presently preferred embodiment, a first side 78 of a rigid substrate 76 is adhesively attached to backing portion 68 on first side 70 of flex circuit 64 for support when image sensor package 74 is later placed on carrier substrate 38. Rigid substrate 76 may be prefabricated with flex circuit 64 before connection of image sensor chip 2 thereto, or may be attached at a later point during formation of image sensor package 74. Rigid substrate 76 may be formed of any suitably rigid material. It may be formed, for example, of a metal (suitably electrically insulated from conductive traces 26) which would also aid in heat dissipation when attached to image sensor chip 2. Furthermore, rigid substrate 76 may itself be formed with conductive traces with ends extending from second attachment points 30 to locations over vias

arranged to correspond with vias 27 and disposed on the outside of backing portion 68 with its vias and aligned with vias 27 on flex circuit 64. A second side 80 of rigid substrate 76 is further adhesively attached to back surface 6 of image sensor chip 2 to hold flex circuit 64 in the folded position. Conventional adhesives may be used for attaching rigid substrate 76 to flex circuit 64 and image sensor chip 2. Alternatively or additionally, rigid substrate 76 may be held in place with stand-off structures 82 attached between second side 80 thereof and first side 70 of flex circuit 64 on mounting portion 66. Stand-off structures 82 may be integrally formed with rigid substrate 76 (as by molding) and attached to mounting portion 66, or may be separate structures attached by any known methods, for instance, by adhesive bonding or press-fitting into apertures therein.

Please replace paragraph number **[0050]** with the following rewritten paragraph:

[0050] As with backing cap 48 in the third embodiment, discrete conductive elements 34 may be attached to or formed on second attachment points 30, or may be omitted to form a ~~land-grid-array type~~ land-grid array-type package.

Please replace paragraph number **[0051]** with the following rewritten paragraph:

[0051] FIG. 16 shows a flow chart of an exemplary method of assembly for the fourth embodiment of the present invention. First, in action 400, mounting portion 66 having aperture 46 and first attachment points 28 is adhesively secured to transparent substrate 18. In action 402, image sensor chip 2 is flip-chip mounted by bonding conductive bumps 14 to first attachment points 28. In action 404, a bead of sealant is deposited around image sensor chip 2, contacting sides 8 and first side 70 of flex circuit 64. In action 406, backing portion 68 having optionally preattached rigid substrate 76 and a fully populated array of second attachment points 30 is bent over and secured in place with an adhesive material previously applied to second side 80 of rigid substrate 76 and/or to back surface 6 of image sensor chip 2. Alternatively or additionally, backing portion 68 is secured by the use of stand-off structures 82. Finally in action 408, if a ~~land-grid-array type~~ land-grid array-type package is not desired,

discrete conductive elements 34 are formed on or attached to the full array of second attachment points 30 on second side 72 of flex circuit 64.